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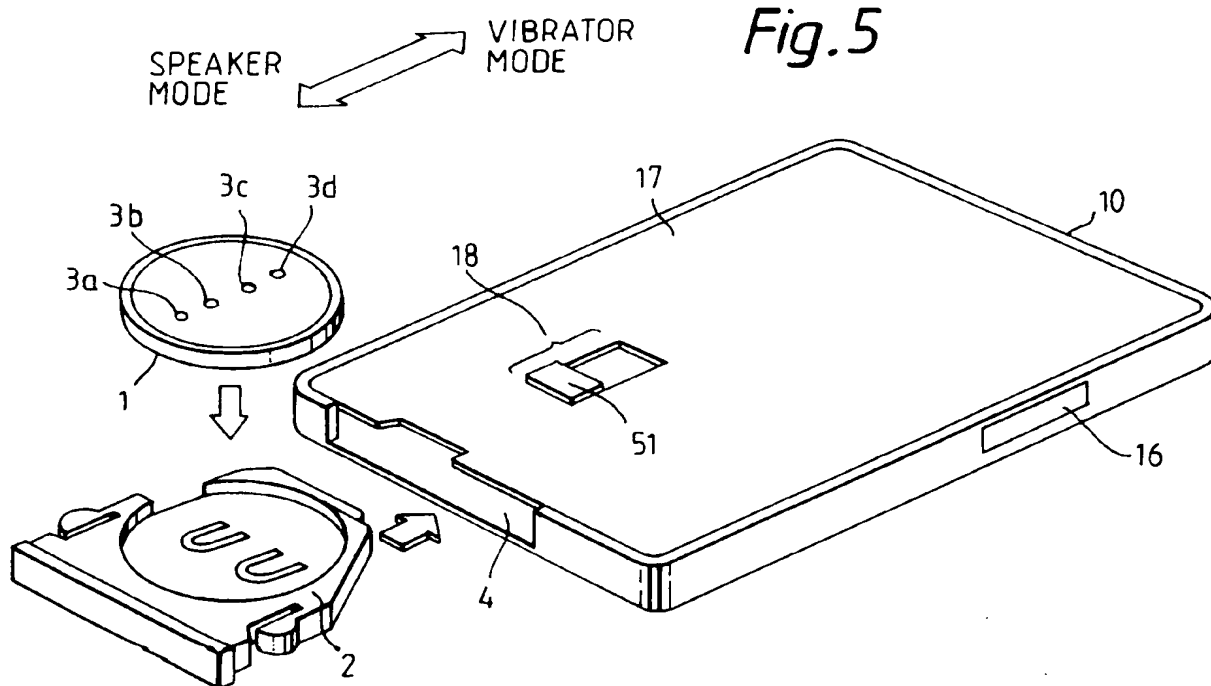
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(54) **Radio paging receiver using an air battery.**

(57) A radio paging receiver which enables a user to use the functions of a vibrator, a loud speaker or the like to notify the user of an incoming message, even when an air battery is used as the power source. The radio paging receiver includes an air battery having air holes for introducing air inside the battery, a notifying device such as a vibrator, a speaker and an LED, and adjusting mechanism for adjusting the amount of air introduced into the air battery according to the maximum current consumption which varies with the selected notifying device. The adjusting mechanism comprises a rubber plate for covering the air holes of the air battery. When the vibrator, which requires large current, is selected as the notifying device, the number of opened air holes is increased so as to increase the amount of introduced air, so that the air battery can generate the necessary large current.



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## BACKGROUND OF THE INVENTION

### Field of the Invention

The present invention relates to a radio paging receiver using an air battery as the power source, and more particularly to a control mechanism for controlling the load current of the air battery.

### Description of the Related Art

Generally, a manganese battery, a lithium battery, a nickel-cadmium battery or the like is used as the power source of a radio paging receiver.

To better understand the present invention, a brief reference will be made to a prior art radio paging receiver using a manganese battery as the power source, shown in Fig. 1.

A radio signal received by an antenna 301 is amplified and demodulated by a radio section 302, and the received data are further sent to a decoder 304 via a wave form shaping section 303. If an individual paging number registered in a ROM 305 is found to be identical to the received paging number, the bearer of the radio paging receiver will be notified of the call by the actuation of a loud speaker 309, the actuation of a vibrator 317 and/or the intermittent lighting of an LED 307. Also, as required, the received message will be simultaneously displayed on a display 312 by a CPU 310 and stored in a RAM 311.

The actuation of the loud speaker is accomplished by a speaker driver 308, actuation of the vibrator 317 is accomplished by a vibrator driver 316, and the intermittent lighting of the LED 307 is accomplished by an LED driver 306, all under the control of the decoder 304. A power supply switch 314 turns on and off the supply of power to the radio paging receiver. A manganese battery is used as a power source 315.

A low voltage detecting circuit 313 notifies the decoder 304 of any drop in the source voltage below the minimum required voltage for having the radio section 302 stably operate (hereinafter referred to as the LVA voltage), and sounds the loud speaker 309 via the speaker driver 308 (hereinafter referred to as a low voltage alarm, which will continue to sound until the bearer of the receiver recognizes the alarm and performs an action, such as turning the switch off) to inform the bearer of the receiver to replace the battery. It is noted that the voltage for stable operation of the decoder 304 is about 1.0 volt, and the LVA voltage is set at about 1.1 volts, where no deterioration of sensitivity will occur.

In recent years, along with the increased variety and diversification of radio paging receivers, the variety of batteries used in the paging receivers has increases, with air batteries having joined the batteries already in conventional use. For example, air batteries are particularly useful in the card type paging re-

ceiver due to their slim profile.

Fig. 2 shows one example of a conventional radio paging receiver using an air battery. An air battery 1 mounted on a battery holder 2 is inserted into a battery accommodating section 4, which is a part of the housing case 7 of the radio paging receiver, and used as the power source of the paging receiver. Reference numeral 6 denotes a power supply switch of the paging receiver. The air battery 1 has air holes 3 for allowing air to enter the battery and chemically react with a chemical substance inside the battery to thereby generate a voltage. For example, such an air battery using zinc is generally called "zinc air", and is supplied by DURACELL INC.

Fig. 3 illustrates the variations of the internal impedance of the air battery relative to the air contact area (i.e., the total area of the air holes in the battery which allows air to flow inside the battery). An air battery, as shown in Fig. 3, has the characteristic that its internal impedance varies with the air contact area and, attendantly, with the amount of air introduced through the air holes (as the air contact area doubles, the internal impedance decreases by about 20%). However, if the air contact area is increased, the service life of the air battery will be shortened due to battery discharge.

Fig. 4 comparatively illustrates the voltage drops of a manganese battery and an air battery, used as the power source of a radio paging receiver, when the vibrator is driven. As can be seen, a radio paging receiver using an air battery as the power source suffers a greater voltage drop when the vibrator is actuated than does a radio paging receiver using a manganese battery.

In this conventional radio paging receiver, when a circuit or unit requiring a large current, for instance a vibrator, is used, the operation of its radio section 302 is stopped because a large voltage drop occurs so that the battery voltage falls below the LVA voltage. Thus, if an air battery capable of actuating the vibrator is used, the air contact area should be greater so as to reduce the impedance and, attendantly the voltage drop. However, as noted above, while increased air flow reduces impedance it also has the negative effect of increased discharge even when a function is performed which draws a minimum current.

### SUMMARY OF THE INVENTION

It is an object of the present invention to provide a radio paging receiver which enables the use of the vibrator and the like, even when an air battery is used as the power source.

In accordance with one aspect of the invention there is provided a radio paging receiver for use with an air battery as a power source, the air battery having means permitting the introduction of air into said

battery, wherein the improvement comprises. adjusting means for adjusting the amount of air introduced inside said battery through said introducing means in accordance with the operational state of the radio paging receiver.

In accordance with another aspect of the present invention, a radio paging receiver includes an air battery having a plurality of air holes and an adjusting mechanism for optimally adjusting the amount of air that is introduced inside the battery depending on the operational state of the radio paging receiver.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

The above object and feature of this invention will become more apparent from the following detailed description when taken in conjunction with the attached drawings, in which:

Fig. 1 is a block diagram illustrating an example of prior art radio paging receiver;

Fig. 2 is an exploded perspective view of one example of a radio paging receiver according to the prior art using an air battery;

Fig. 3 is a diagram illustrating the variations of the internal impedance of the air battery relative to the air contact area;

Fig. 4 is a diagram comparatively illustrating the voltage drops of a manganese battery and an air battery;

Fig. 5 is an exploded perspective view of an embodiment of the present invention;

Fig. 6 is a perspective view of the mode selecting switch of the embodiment in detail;

Fig. 7 is a perspective view of the embodiment of the present invention and showing the state of speaker mode;

Fig. 8 is a partially sectional view of the embodiment showing the relation between the mode selection switch and the air holes of the air battery;

Fig. 9 is a perspective view of the embodiment of the present invention and showing the state of vibrator mode;

Fig. 10 is a block diagram of the embodiment of the present invention; and

Fig. 11 is a diagram comparatively illustrating the voltage drop of the air battery when the air holes are expanded and not expanded.

In the drawings, the same reference numerals denote the same structural elements.

### **DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring to Figs. 5 to 9, a radio paging receiver 10 embodying the present invention is shown and comprises a housing case 17, a battery holder 2 and an air battery 1. The air battery 1 having air holes 3a, 3b, 3c and 3d, is mounted on the battery holder 2

which is received in a battery accommodating section 4. The housing case 17 has a power supply switch 16 and a slidable mode selecting switch 18 for selecting a speaker mode or a vibrator mode.

As shown in Figs. 6 and 8, the mode selecting switch 18 comprises a switch body 51 which is slidable in the housing case 17 and a rubber plate 52 which is adhered to a back face of the switch body 51. The rubber plate 52 is provided for covering air holes 3c and 3d of the air battery 1 in the speaker mode (described in more detail hereinafter). Further, one end of the switch body 51 is engaged with a slide switching device 20 on a printed circuit board 19 included in the housing case 17. The switching device 20 is provided for electrically switching between the speaker mode and the vibrator mode. Namely, a recess 511 provided at the end of the switch body 51 is engaged with a slidable switch 201 of the slide switching device 20. When the mode selecting switch 18 is slid by the user of the paging receiver, the slidable switch 201 of the switching device 20 is also slid in synchronization with the switch 18, so that the alert mode of the paging receiver is correspondingly switched.

A block diagram of this embodiment is shown in Fig. 10, in which the same constituent element as in the prior art shown in Fig. 1 are assigned respectively the same numerals. The embodiment also includes the slide switching device 20 and a mode set terminal 318 connected to the decoder 304. The decoder 304 can detect the selected mode by the mode set terminal 318.

Next, with reference to Figs. 5 to 10, the operation of the embodiment will be described.

In the case in which notification to the bearer is carried out by the speaker 309 and the LED 307 (the vibrator is not used), the paging receiver is used in the speaker mode as shown in Figs. 5, 7 and 8. At that time, the mode set terminal 318 of the decoder 304 is connected to ground (Low level) by the switching device 20 so as to inform the decoder 304 (Fig. 10). In the speaker mode, although the air holes 3a and 3b of the air battery 1 are open, the air holes 3c and 3d are covered by the rubber plate 52 of the mode selecting switch 18. Therefore, air flows into the battery only through two air holes 3a and 3b, so that the air contact area is relatively small.

Next, when any notifying function requiring a large current (and an attendant large voltage drop of the air battery) such as the vibrator 317 is to be used, the mode selecting switch 18 is slid in the reverse direction (vibrator mode position) so that the rubber plate 52 no longer covers holes 3c and 3d of the air battery 1 (Fig. 9). Thus, when the mode selecting switch 18 is in the vibrator mode the number of open holes increases so that the air contact area also increases. Simultaneously, the switching device 20 is also switched to the vibrator mode position so as to interconnect the mode set terminal 318 and the pow-

er supply (High level) (Fig. 10). The decoder 304 detects this switching and controls the pager so as to notify the bearer using the vibrator 317 and the LED 307 when the paging receiver receives a message.

Fig. 11 illustrates the voltage drop occurring at the time when the vibrator 317 is driven with all four of the air holes opened (denoted by A) in comparison with the case of the prior art (denoted by B) in which only two of the air holes are opened. Referring to this figure, it is seen that the paging receiver of the embodiment suffers a smaller voltage drop than the paging receiver of the prior art.

As stated above, the present invention makes it possible to adjust the air contact area (the internal impedance of the air battery 1) by sliding the mode selecting switch 18 to vary the number of open air holes of the air battery 1. Thus, as the size of the air contact area is made adjustable according to the current use, a large current can be obtained without sacrificing the service life of the battery.

Although the present invention has been fully described by way of a preferred embodiment thereof with reference to the accompanying drawings (which description and drawings are by way of example only), various changes and modifications will be apparent to those having skill in this field. Therefore, unless these changes and modifications otherwise depart from the scope of the present invention as defined by the appended claims, they should be construed as included therein.

## Claims

1. A radio paging receiver for use with an air battery as a power source, the air battery having means permitting the introduction of air into said battery, wherein the improvement comprises:

adjusting means for adjusting the amount of air introduced inside said battery through said introducing means in accordance with the operational state of the radio paging receiver.

2. A radio paging receiver as claimed in Claim 1, including as a power source an air battery having means for permitting the introduction of air into the battery.

3. The radio paging receiver as claimed in Claim 1 or Claim 2, wherein the introducing means comprises a plurality of air holes.

4. A radio paging receiver including an air battery as a power source, the air battery having a plurality of air holes introducing air inside said battery, wherein the improvement comprises:

adjusting means for adjusting the amount of air introduced inside said battery through said

holes depending on the operation state of the radio paging receiver.

5. The radio paging receiver as claimed in Claim 4, further comprising notifying means for notifying a user of a received message, said notifying means including at least one of a loud speaker, an LED and a vibrator, and wherein said adjusting means is interlocked with said notifying means.

6. The radio paging receiver as claimed in Claim 4, comprising:

notifying means for notifying a user of a received message, said notifying means including at least two notification formats;

means for selecting one of said notification formats; and

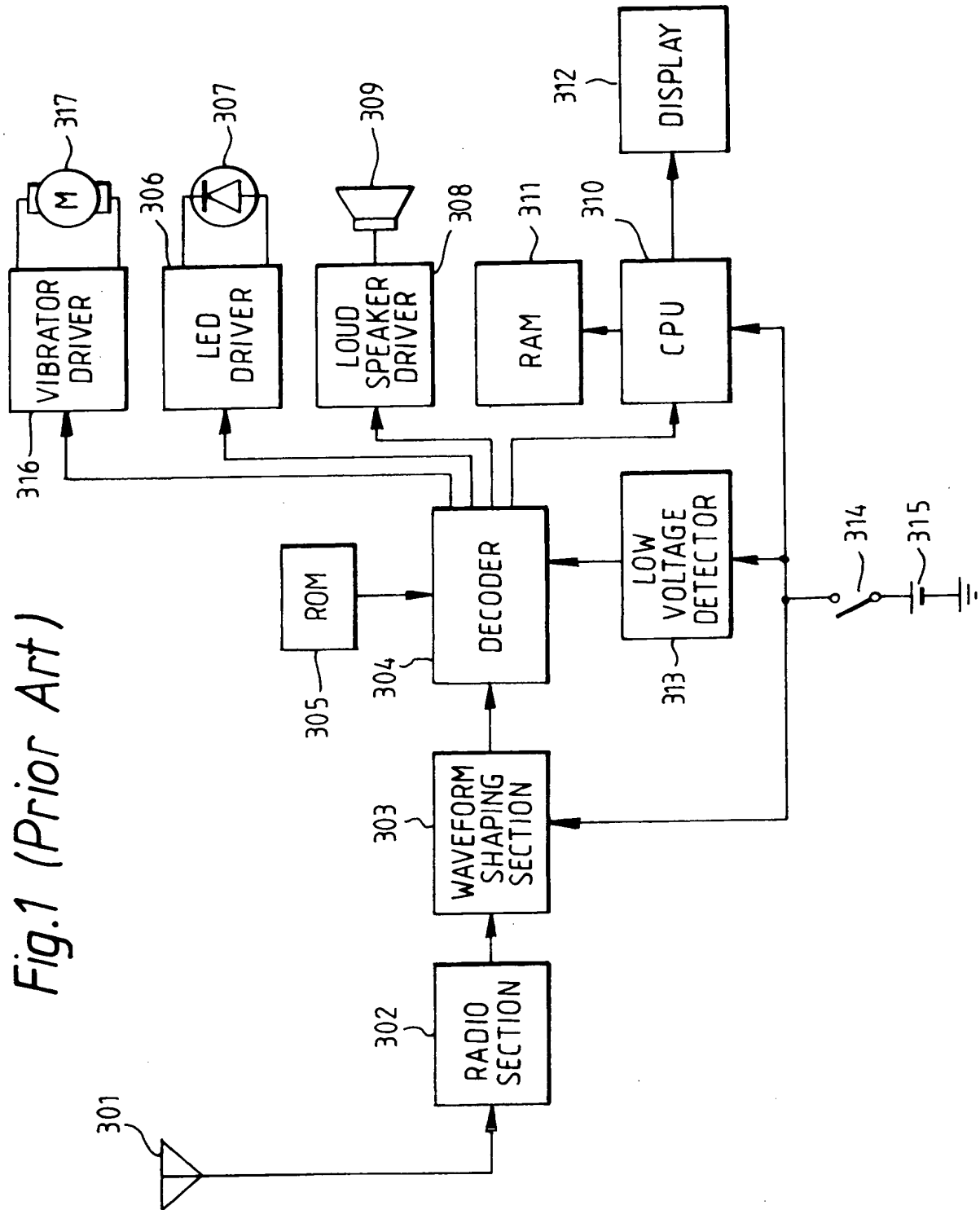
adjusting means for adjusting the amount of air that flows inside said air battery through said holes in accordance with which one of said notification formats is selected by said selecting means.

7. The radio paging receiver as claimed in Claim 5 or Claim 6, wherein said adjusting means comprises a switch means for selectively opening and closing at least one of said air holes.

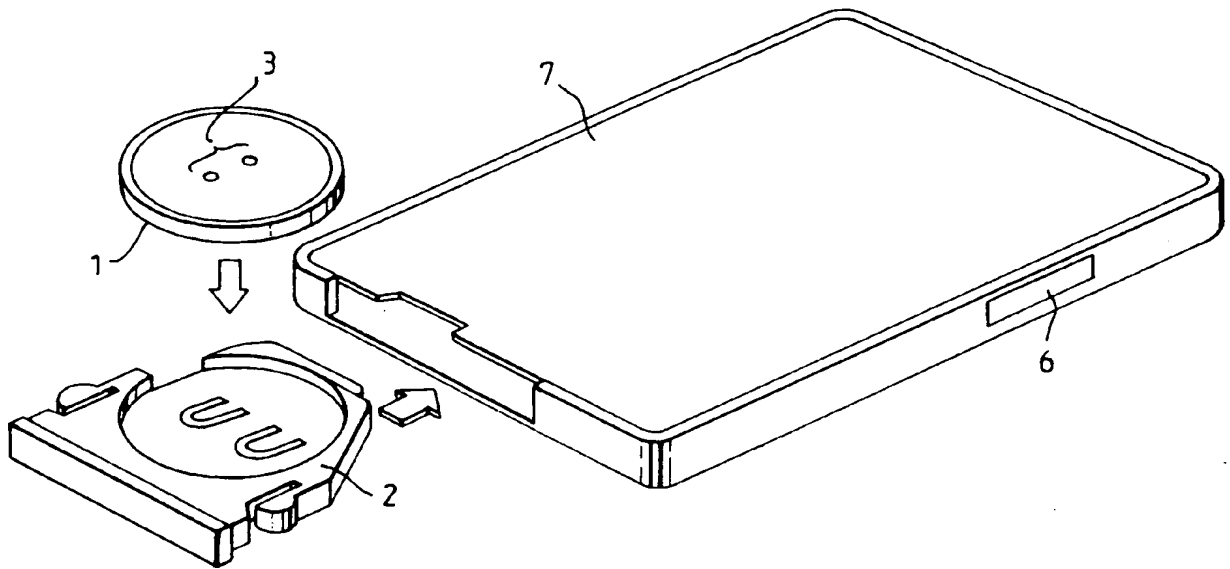
8. The radio paging receiver as claimed in Claim 7, wherein the maximum current available to said receiver increases as the number of opened holes increases.

9. The radio paging receiver as claimed in Claim 6, wherein said adjusting means comprises cover means for covering said holes, and wherein said amount of air that flows inside said battery is varied by changing the number of holes covered by said cover means.

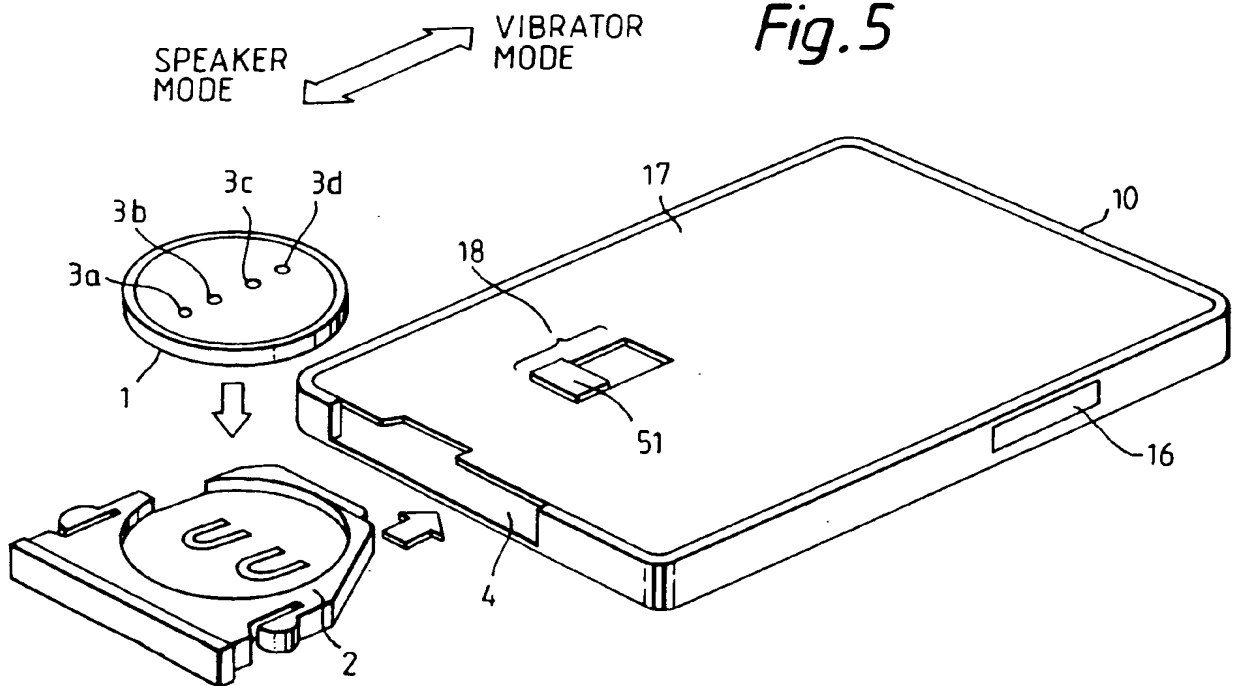
10. The radio paging receiver as claimed in Claim 9, wherein said cover means is interlocked with said selecting means.



*Fig.2 (Prior Art)*



*Fig.5*



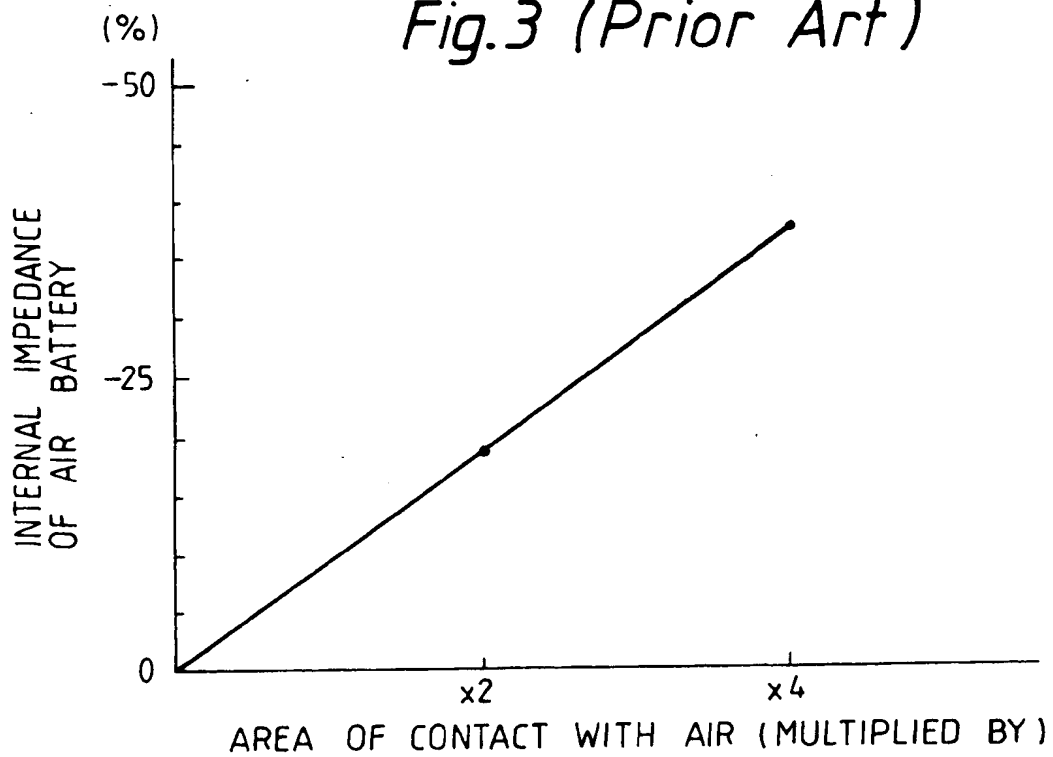
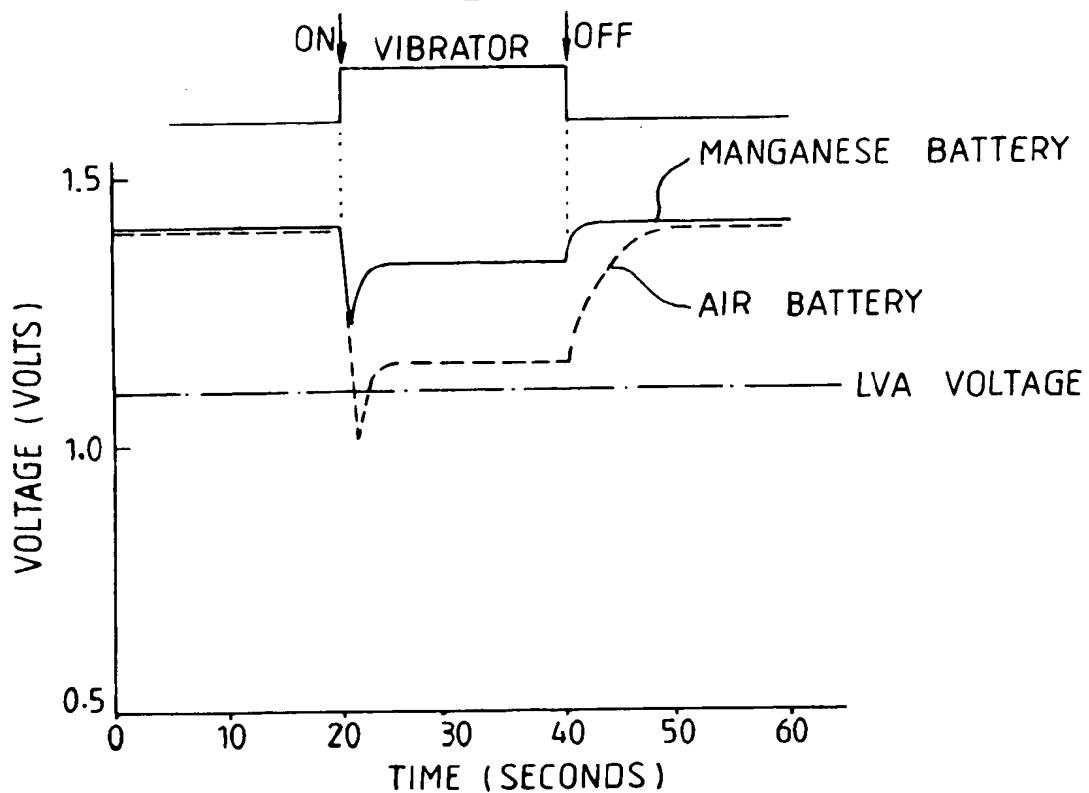
*Fig.3 (Prior Art)**Fig.4 (Prior Art)*

Fig.6

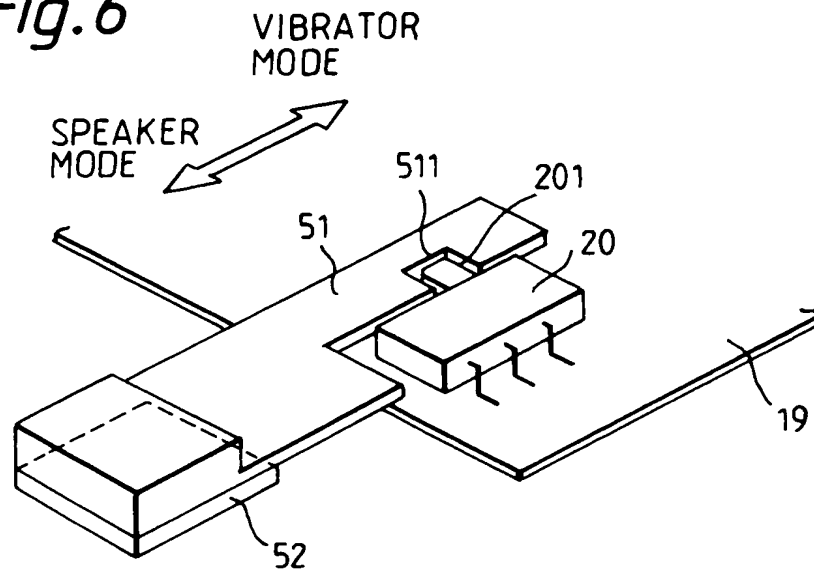


Fig.7

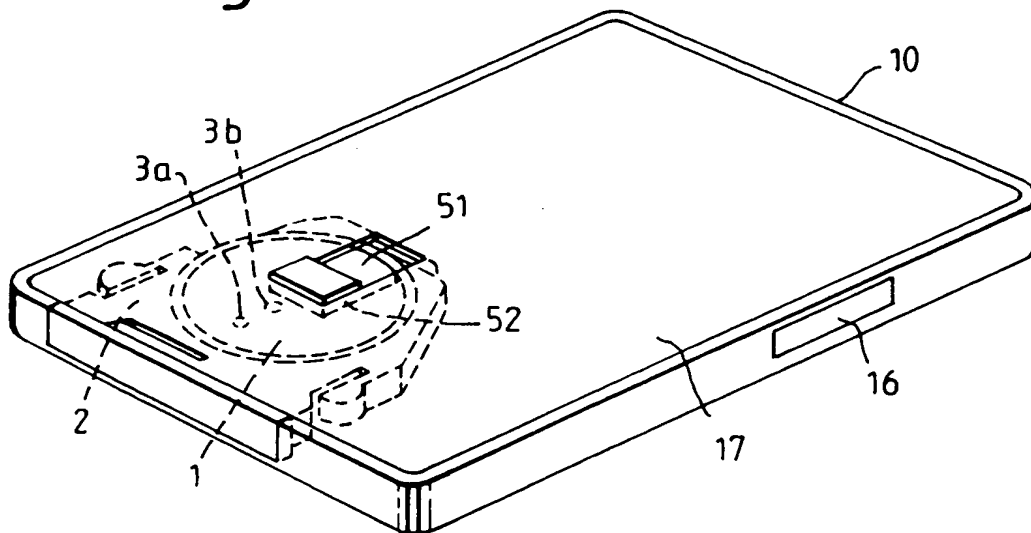




Fig. 8

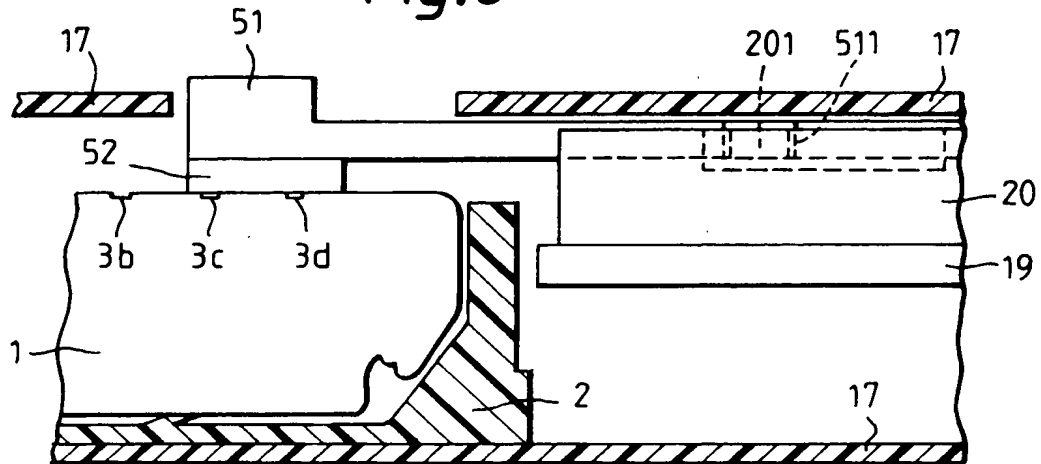
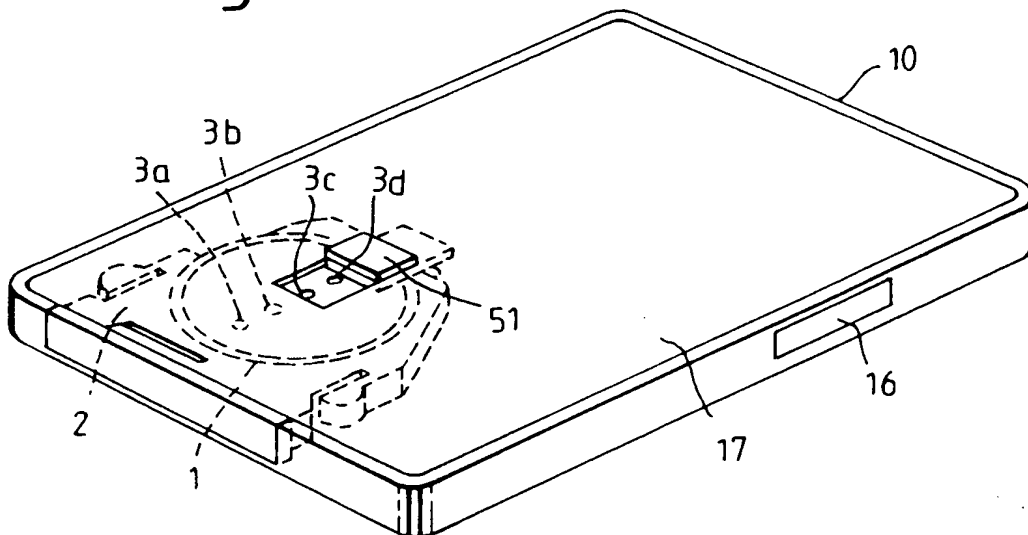


Fig. 9



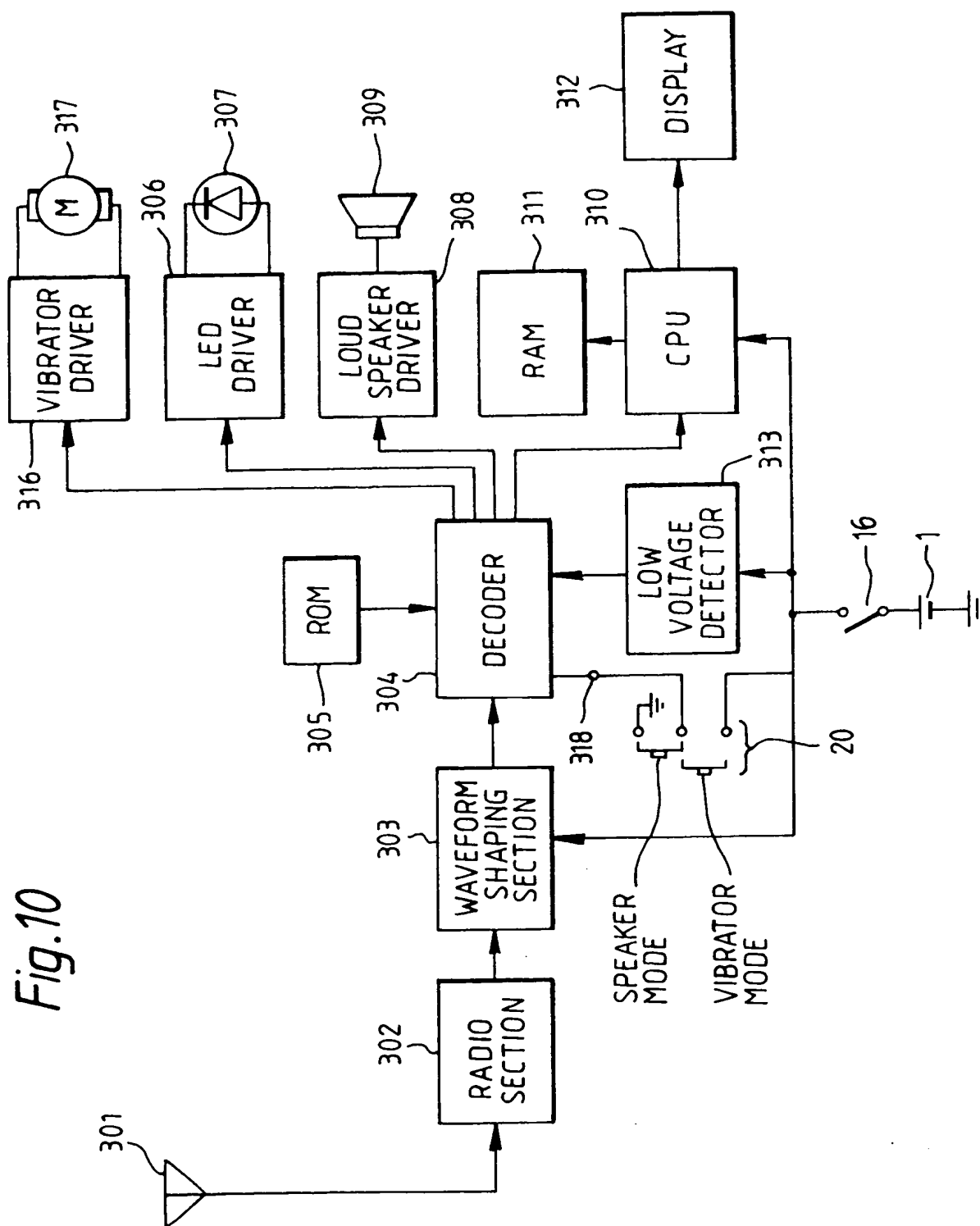
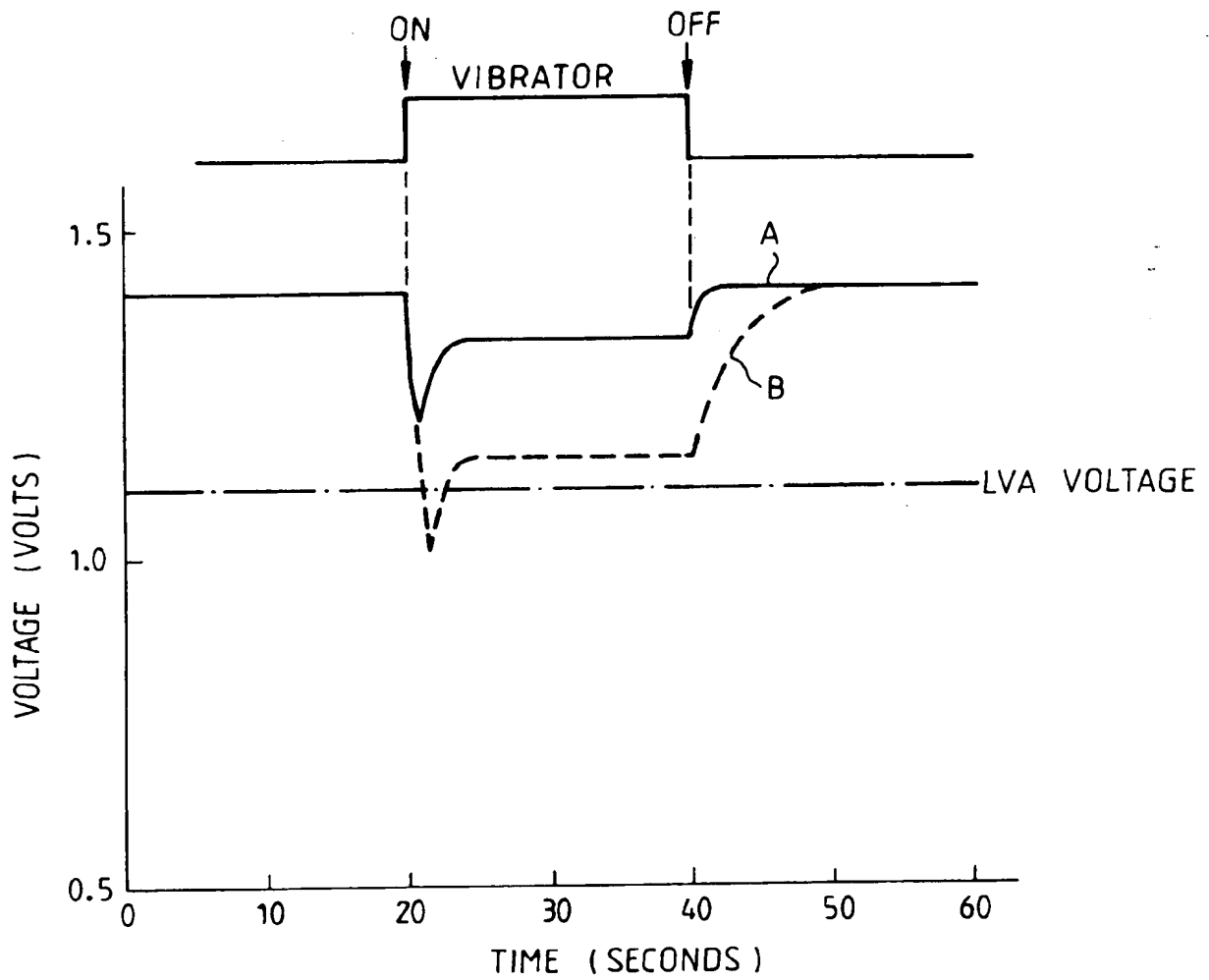


Fig. 10

*Fig.11*







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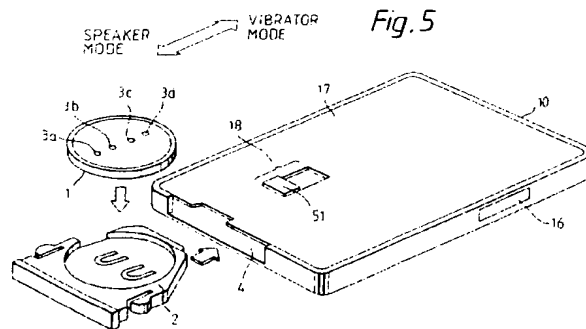
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European Patent  
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# EUROPEAN SEARCH REPORT

Application Number  
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	US-A-5 093 212 (LLOYD ET AL.) * the whole document * -----	1-10	H04B1/16 H04B1/08
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			H04B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		28 July 1994	Goulding, C
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